Amendment to the Claims

This listing of Claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

1. (Currently Amended) A method of manufacture by micrometre and nanometre scale spatially selective deposition of chemical substances on a substrate, the method including the steps of:

(a) defining at least one region on the substrate by forming an electrostatic charge on that region which is different from the electrostatic charge on other regions of the substrate,

(b) applying an emulsion to the substrate, the emulsion including an electrically insulative continuous phase and an electrically charged discontinuous phase and a component to be selectively deposited carried in or comprising the discontinuous phase, the emulsion comprising a surfactant, the surfactant having a first part which is compatible with the continuous phase and a second part which is compatible with the discontinuous phase, the surfactant being selected to not significantly reduce the volume resistivity of the continuous phase, and

(c) directing the discontinuous phase of the emulsion to the at least one region by attraction to or repulsion from the electrostatic charge on the region,

wherein the substrate comprises:

a support,

a conductive layer on the support,

a dielectric layer of a material which will hold an electric charge disposed on the conductive layer, and

a chemically functional layer on the dielectric layer.

2. (Original) A method as in Claim 1 wherein the component to be selectively deposited is selected from the group comprising a bio-active agent, an activated nucleoside amidite (A, C, G or T), an activated oligonucleotide, a reagent or reactant including acids and bases, a blocking chemical, a de-blocking chemical, an organic or inorganic derivatisation chemical, a catalyst, a pharmaceutical, a dye or a pigment.

3. (Original) A method as in Claim 1 further including the step of carrying out repetition of steps (a) to (c) to provide a stepwise deposition process at the same or alternative positions on the substrate and to achieve combinatorial synthesis on the substrate.

4. (Currently Amended) A method of manufacture by micrometre and nanometre scale spatially selective deposition of chemical substances on a substrate, the method including the steps of:
(a) defining at least one region on the substrate by forming an electrostatic charge on that region which is different from the electrostatic charge on other regions of the substrate,
(b) applying an emulsion to the substrate, the emulsion including an electrically insulative continuous phase and an electrically charged discontinuous phase and a chemical reagent to participate in forming the solid phase array carried in or comprising the discontinuous phase, the emulsion comprising a surfactant, the surfactant having a first part which is compatible with the continuous phase and a second part which is compatible with the discontinuous phase, the surfactant being selected to not significantly reduce the volume resistivity of the continuous phase,
(c) depositing the discontinuous phase of the emulsion to the at least one region by attraction by the electrostatic charge on the region and optionally by the use of bias voltage to reduce deposition in non-required regions,

(d) causing a chemical or physical reaction in the at least one region, and

(e) removing the emulsion,

wherein the substrate comprises:

a support,

a conductive layer on the support,

a dielectric layer of a material which will hold an electric charge disposed on the conductive layer, and

a chemically functional layer on the dielectric layer.

5. (Original) A method as in Claim 4 further including the step of carrying out repetition of steps (a) to (e) to provide a stepwise deposition process at the same or alternative positions on the substrate.

6. (Original) A method as in Claim 4 further including the step of flooding with a further reagent wherein reaction of the further reagent only occurs where the spatially selective deposition had previously occurred.

7. (Currently Amended) A method of forming a solid phase chemical array on a substrate using a stepwise reaction process, the method including the steps of:

(a) defining at least one region on the substrate by forming an electrostatic charge on that region which is different from the electrostatic charge on other regions of the substrate,

(b) applying an emulsion to the substrate, the emulsion including an electrically insulative continuous phase and an electrically charged discontinuous phase and a chemical reagent carried in or comprising the discontinuous phase, the emulsion comprising a surfactant, the surfactant having a first part which is compatible with the continuous phase and a second part which is compatible with the discontinuous

phase, the surfactant being selected to not significantly reduce the volume resistivity of the continuous phase,

(c) depositing the discontinuous phase of the emulsion to the at least one region by attraction by the electrostatic charge on the region and optionally by the use of a bias voltage to reduce deposition in non-required regions,

(d) causing a chemical reaction in the at least one region,

(e) removing the emulsion, and

(f) carrying out subsequent steps of the stepwise reaction process, wherein the substrate comprises:

a support,

a conductive layer on the support,

a dielectric layer of a material which will hold an electric charge disposed on the conductive layer, and

a chemically functional layer on the dielectric layer.

8. (Original) A method as in Claim 6 wherein the step of applying the emulsion to the substrate includes the step of applying a coating to the substrate of the liquid of the continuous phase or other liquid before applying the emulsion.

9. (Currently Amended) A method of forming a DNA array on a substrate using a stepwise coupling process with a chemical de-protecting step prior to each coupling step, the method including the steps of:

(a) preparing a substrate with surface functional groups protected by a removable protecting group;

(b) defining at least one region on the substrate by forming an electric field on that region which is different from the electric field on other regions of the substrate,

(c) applying an emulsion to the substrate, the emulsion including an electrically insulative continuous phase and an electrically charged discontinuous phase and a

chemical de-protecting reagent carried in the discontinuous phase, the emulsion comprising a surfactant, the surfactant having a first part which is compatible with the continuous phase and a second part which is compatible with the discontinuous phase, the surfactant being selected to not significantly reduce the volume resistivity of the continuous phase,

(d) depositing the discontinuous phase of the emulsion to the at least one region by attraction by the electric field on the region and optionally by the use of a bias voltage to reduce deposition in non-required regions,

(e) causing chemical de-protecting in the at least one region,

(f) removing the emulsion, and

(g) carrying out subsequent steps of the stepwise coupling process,

wherein the substrate comprises:

a support,

a conductive layer on the support,

a dielectric layer of a material which will hold an electric charge disposed on the conductive layer, and

a chemically functional layer on the dielectric layer.

10. (Original) A method as in Claim 9 wherein the subsequent steps of the stepwise coupling process are those in the phosphoramidite chemistry for synthesis of oligodeoxynucleotides.

11. (Previously Presented) A method as in Claim 9 wherein the continuous phase of the emulsion comprises a volume resistivity of approximately 1×10^6 ohm-cm or greater.

12. (Original) A method as in Claim 9 wherein the continuous phase of the emulsion is selected from the group comprising hydrocarbons such as hexane,

cyclohexane, iso-octane, decalin, heptane, aromatic hydrocarbons and isodecane and mixtures of hydrocarbons; fluorochemicals including fluorocarbon compounds including linear, cyclic or polycyclic perfluoroalkanes, bis(perfluoroalkyl)alkenes, perfluoroethers, perfluoroalkylamines, perfluoroalkyl bromides and perfluoroalkyl chlorides; silicone fluids such as polyphenylmethyl siloxanes, dimethyl polysiloxanes, polydimethyl siloxanes and cyclic dimethyl siloxanes.

13. (Original) A method as in Claim 9 wherein the continuous phase of the emulsion is a gel or highly viscous liquid.

14. (Original) A method as in Claim 9 wherein the discontinuous phase of the emulsion is non-aqueous and is immiscible or substantially insoluble in the continuous phase.

15. (Original) A method as in Claim 9 wherein the discontinuous phase of the emulsion is selected from the group comprising a reagent, a solvent which carries an active chemical reagent or a carrier liquid for a solid or insoluble liquid dispersed in the discontinuous phase.

16. (Original) A method as in Claim 9 wherein the discontinuous phase of the emulsion is selected from the group comprising acetone, acetonitrile, cyclohexanone, dibromomethane, dichloromethane (methylene chloride, DCM), trichloromethane, dimethyl formamide (DMF), dioxane, 1,2-dichloroethane (DCE), nitromethane, tetrahydrofuran, toluene, decalin, dimethyl formamide, isobutanol, propylene carbonate, dimethyl sulphoxide, commercially available mixtures of hydrocarbons including Isopar™ and Norpar™ or mixtures of compounds such as isopropanol/methylene chloride, nitromethane/methanol, nitromethane/isopropanol, trichloromethane/methanol or isopropanol/methylene chloride.

17. (Original) A method as in Claim 9 wherein the emulsion further includes a charge control agent.

18. (Original) A method as in Claim 17 wherein the charge control agent is selected from the group comprising an inorganic acid and its salts, an organic acid and its salts or an ionic or zwitterionic compound.

19. (Original) A method as in Claim 17 wherein the charge control agent is selected from the group comprising metallic soaps, comprising a metal and an acid wherein the metal is selected from barium, calcium, magnesium, strontium, zinc, cadmium, aluminium, gallium, lead, chromium, manganese, iron, nickel, zirconium and cobalt and the acid portion is a carboxylic acid, caproic acid, octanoic (caprylic) acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, linolic acid, erucic acid, tallitic acid, resinic acid, naphthenic acid and succinic acid; a phospholipid or alkyl succinimide.

20. (Original) A method as in Claim 9 wherein the emulsion comprises the continuous phase present in the range of about 20 to 99.99 per cent by volume, the discontinuous phase present in a range of from about 0.01 to 80 per cent by volume, optionally a surfactant present in a range of about 0.01 to 20 per cent by weight and optionally a charge control agent present in a range of 0.01 to 10 per cent by weight.

21. (Previously Presented) A method as in Claim 9 wherein the emulsion comprising the discontinuous phase has a droplet size of from about 100 microns down to 0.2 microns.

22. (Previously Presented) A method as in Claim 9 wherein the emulsion is a miniemulsion with the discontinuous phase having a droplet size from 500 nanometres down to about 50 nanometres.

23. (Previously Presented) A method as in Claim 9 wherein the emulsion comprises a microemulsion with the discontinuous phase having a droplet size of from about 200 nanometres down to 1 nanometre.

24. (Original) A method as in Claim 9 wherein the step of defining at least one region on the substrate by forming an electrostatic charge on that region includes the step of image reversal to enable deposition in non-charged regions.

25. (Original) A method as in Claim 9 wherein the step of formation of the electrostatic image pattern is by electrostatic means wherein the substrate is a photoconductor and the formation of the electrostatic field is by charging and subsequent discharging by selective illumination.

26. (Original) A method as in Claim 9 wherein the step of removing the emulsion includes the step of neutralising any residual chemical de-capping agent in the emulsion to prevent it from reacting in non-desired parts of the array.

27. (Original) A method as in Claim 9 wherein the chemical deprotection reagent is selected from the group comprising Lewis acids, protic acids, zinc bromide, titanium tetrachloride, and ceric ammonium nitrate, dilute mineral acids, trichloroacetic acid (TCA), dichloroacetic acid (DCA), benzenesulphonic acid, trifluoroacetic acid (TFA), difluoroacetic acid, perchloric acid, orthophosphoric acid, toluenesulphonic acid, dodecylbenzene sulphonic acid and diphenyl acid phosphate.

28. (Canceled)

29. (Previously Presented) A method as in Claim 9 wherein the surfactant is selected from the group comprising anionic, cationic, non-ionic or amphoteric compounds, polymer surfactant materials or phospholipids or fluorinated analogues of these.

30. (Canceled)

31. (Currently Amended) A method as in ~~Claim 30~~ Claim 9 wherein the support is selected from the group comprising metal, glass, ceramic, or polymeric material

32. (Currently Amended) A method as in ~~Claim 30~~ Claim 9 wherein the conductive layer is selected from the group comprising a sputtered layer of metal, indium tin oxide, or salts such as quaternary ammonium salts.

33. (Currently Amended) A method as in ~~Claim 30~~ Claim 9 wherein the dielectric ~~or photoconductor~~ layer is selected from the group comprising glass, a polymeric resin such as Mylar (PET, polyethyleneterephthalate), zinc oxide, cadmium sulphide, amorphous selenium, alloys of selenium such as selenium-tellurium, lead selenide, selenium-arsenic and polyvinylcarbazole (PVK).

34-52.(Canceled)

53. (Previously Presented) A method as in Claim 1 wherein the surfactant is selected from the group comprising anionic, cationic, non-ionic or amphoteric

compounds, polymer surfactant materials or phospholipids or fluorinated analogues of these.

54. (Previously Presented) A method as in Claim 4 wherein the surfactant is selected from the group comprising anionic, cationic, non-ionic or amphoteric compounds, polymer surfactant materials or phospholipids or fluorinated analogues of these.

55. (Previously Presented) A method as in Claim 7 wherein the surfactant is selected from the group comprising anionic, cationic, non-ionic or amphoteric compounds, polymer surfactant materials or phospholipids or fluorinated analogues of these.

56. (New) A method as in Claim 1 wherein the support is selected from the group comprising metal, glass, ceramic, or polymeric material

57. (New) A method as in Claim 1 wherein the conductive layer is selected from the group comprising a sputtered layer of metal, indium tin oxide, or salts such as quaternary ammonium salts.

58. (New) A method as in Claim 1 wherein the dielectric layer is selected from the group comprising glass, a polymeric resin such as Mylar (PET, polyethyleneterephthalate), zinc oxide, cadmium sulphide, amorphous selenium, alloys of selenium such as selenium-tellurium, lead selenide, selenium-arsenic and polyvinylcarbazole (PVK).

59. (New) A method as in Claim 4 wherein the support is selected from the group comprising metal, glass, ceramic, or polymeric material

60. (New) A method as in Claim 4 wherein the conductive layer is selected from the group comprising a sputtered layer of metal, indium tin oxide, or salts such as quaternary ammonium salts.

61. (New) A method as in Claim 4 wherein the dielectric layer is selected from the group comprising glass, a polymeric resin such as Mylar (PET, polyethyleneterephthalate), zinc oxide, cadmium sulphide, amorphous selenium, alloys of selenium such as selenium-tellurium, lead selenide, selenium-arsenic and polyvinylcarbazole (PVK).

62. (New) A method as in Claim 7 wherein the support is selected from the group comprising metal, glass, ceramic, or polymeric material

63. (New) A method as in Claim 7 wherein the conductive layer is selected from the group comprising a sputtered layer of metal, indium tin oxide, or salts such as quaternary ammonium salts.

64. (New) A method as in Claim 7 wherein the dielectric layer is selected from the group comprising glass, a polymeric resin such as Mylar (PET, polyethyleneterephthalate), zinc oxide, cadmium sulphide, amorphous selenium, alloys of selenium such as selenium-tellurium, lead selenide, selenium-arsenic and polyvinylcarbazole (PVK).

65. (New) A method as in Claim 1 wherein the dielectric layer is a photoconductive layer.